FISSURES OF THE JILIN METEORITE

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***Abstract*:** Observations with the naked eye and a microscope revealed that there are many fissures in the Jilin meteorite. They may be divided into two kinds; one is filled with dark material and the other is not. The former includes shear fissure and tension fissure. The latter is fresh.

Conjugate shear fissures, filled with dark material, are widely spread in the Jilin meteorite. The morphological characteristics are similar to those of the shear joints in the terrestrial rocks. Shear fissures are not generated by the force of impact but by the tectonism. The same type of shear fissure is also seen in other meteorites, such as those in pictures by RAMDOHR (The Opaque Minerals in Stony Meteorites, Berlin, Akademie, 1973).

Fissure is a structural phenomenon which often appears in meteorites. It is a mechanical relic after the meteorite is formed, and reflects the mechanical processes experienced by the meteorite after its formation.

Among the large and small fragments in the Jilin meteorite shower, the fissure structure exists widely to a large extent and can be seen with the naked eye and under a microscope. Fundamentally they can be classified into two kinds. One is filled with dark material and the other is non-filled fresh fissure. The difference between the two is quite distinct.

Generally the fresh fissures all cut through the fusion crust and penetrate into the interior of the meteorite. The cross-sectional form of the fissure is mostly uneven bend. Examined under a microscope, this kind of fissure is free of any filled material. Most of the crack plane of the bend pass through the contact plane of a grain and a crystal. Mixed fragments can be found also. These fissures apparently cut through the other fissures filled with materials. The geometric characteristic of the fissure is congruent with the form of fracture plane of each piece of fragments. From the above-mentioned characteristics it may be explained that a kind of tension fissure is formed in the final stage of the history of mechanical relics in the formation of the texture and structure of meteorites. The major reason is when the meteorite penetrates into the atmosphere frictioning against it and receiving an intensive pressure, it leads to an explosion. The meteorite impact on the surface of the earth can also bring about a partial tension fissure.

The fissures filled with dark material are also widely generated. According to

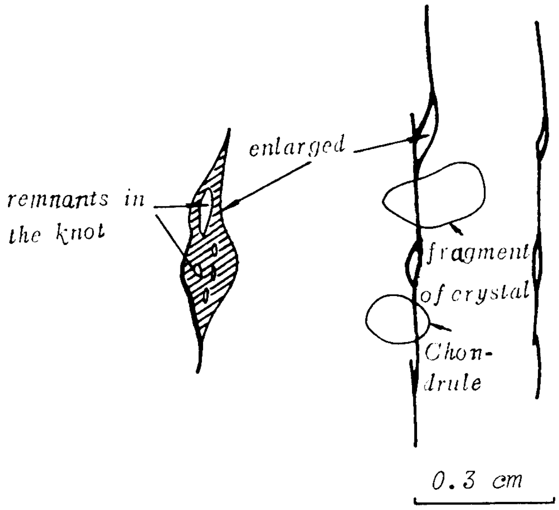

Fig. 1. A group of shear fissure and its rhombic knot phenomenon.

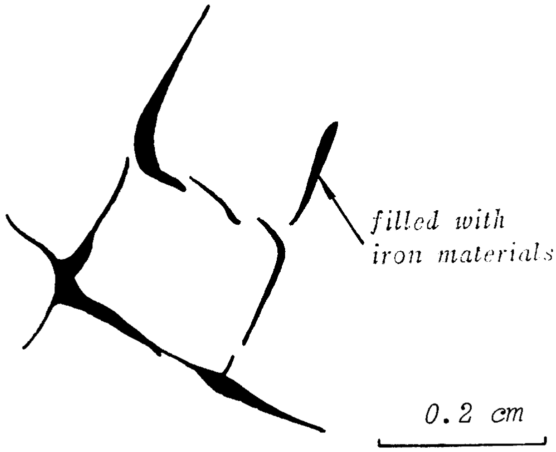

Fig. 2. Conjugate phenomena of shear fissure.

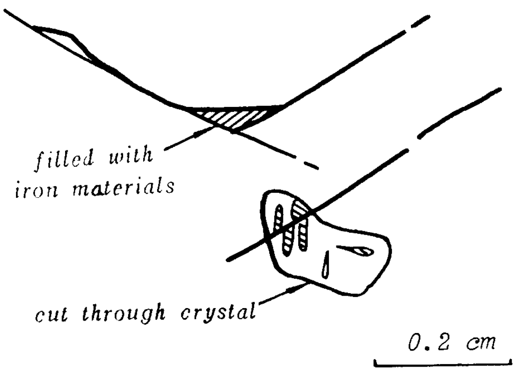

Fig. 3. Conjugate shear fissure in two groups.

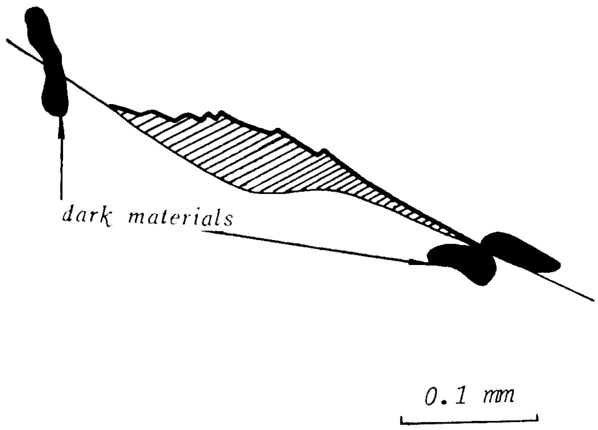

Fig. 4. Plumose of shear fissure.

Fig. 5. Net characteristic of tension fracture.

Fig. 6. The chondrule cut through by shear fissure in the Jilin meteorite.

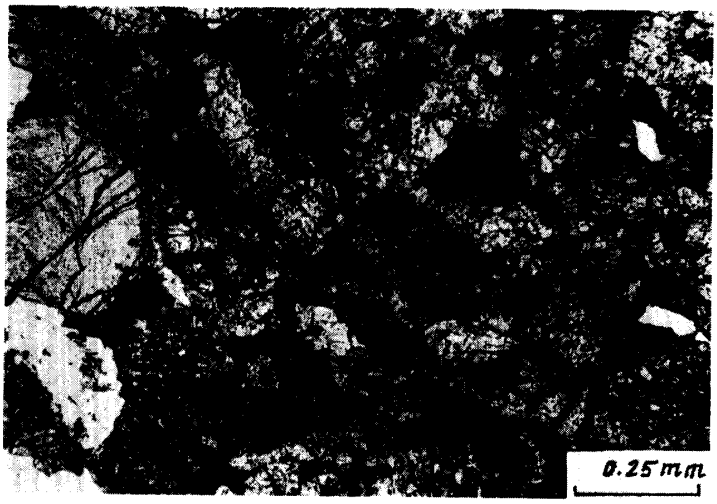

Fig. 7. The shear fissure in the Jilin meteorite.

Fig. 8. A group of shear fissure and its rhombic knot phenomenon in the Jilin meteorite.

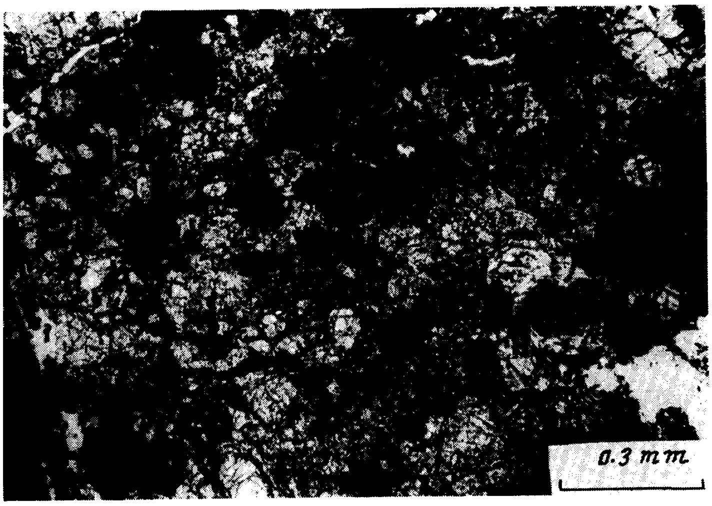

Fig. 9. *A group of shear fissure in the Jilin meteorite.*

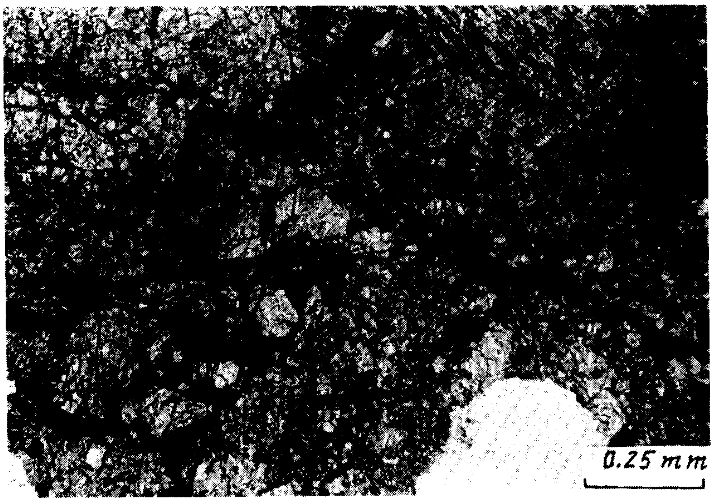

Fig. 10. *Conjugate phenomena of shear fissures in Jilin meteorite.*

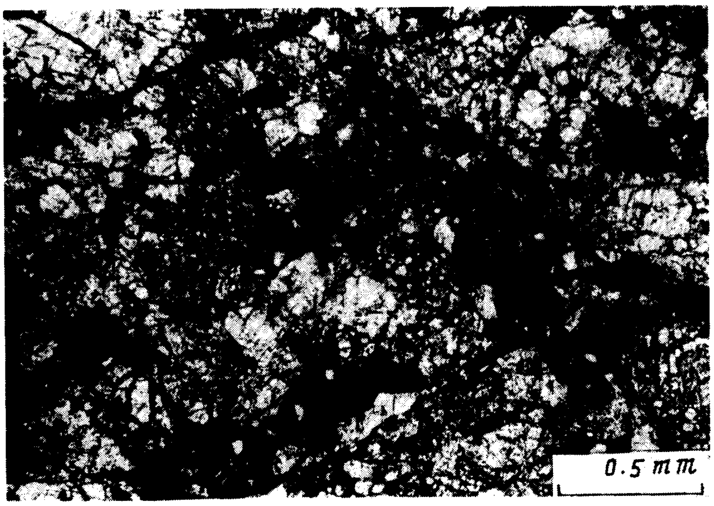

Fig. 11. *Conjugate phenomena of two groups of shear fissure in the Jilin meteorite.*

Fig. 12. A group of shear fissure in the Jilin meteorite.

Fig. 13. The opaque mineral dislocated by shear fissure (by RAMDOHR, *1973).*

the observation of 41 thin sections sliced from different fragments of meteorites, 26 of which were of this kind. It can be understood that the generation frequency is rather high. Among the 26 sections, 21 of them showed the characteristics similar to the shear joints of terrestrial rocks; the other 5 showed only the tension joints. The characteristics of the shear fissure can be summarized as: 1) erect and smooth form, extension in a group arrangement (Figs. 2, 3, 7, 9, 10, 11, 12); 2) dissected even into the displacement of single unit of chondrule, rock fragment, crystal, etc. (Figs. 1, 3, 6, 13); 3) on the fracture plane is found the rather regular plumose arrangement or plumose structure fracture plane (Figs. 4, 8); 4) two groups of the shear fissure are conjugated (Figs. 2, 11), the end of which shows the characteristic rhombic knot phenomenon (Figs. 1, 4, 8). The characteristics of the tension fissure are: 1) in a curved form and irregular stretch; 2) mostly passing through round crystal or chondrule and fundamentally not dissecting the crystal or the chondrule; 3) the end of fissure shows the branching out like the roots of a tree (Fig. 5).

Iron, nickel and other elements (by an electron probe analysis) or dark glass, are the major materials filling the fissure, the rest are to be analyzed further. The black materials besides fillings along the fissure are concentrated mainly near some of the complex spots of the structure, such as the conjugate spot of the fissure, the position of the rhombic knot, and the space in the joint of plumose and fissure staircase form (Figs. 2, 3, 8, 11). The situation of filling is similar to a lode vein or dyke vein. The free distribution of the black materials, some of which were dissected by a fissure, explains that the fissure occurred afterwards, but the fissure itself again was filled with some other black materials. It also explains that the black materials can be divided into at least two periods, and the fissure which is now and then cutting in during the formation of the structure of meteorites is the mechanical expression in the final stage of the history of formation.

What has been said above is that the fissure filled with material can be compared with the fissure structure of other meteorites, such as the microscopic photos collected by RAMDOHR (Fig. 13, 1973) and others. A lot of similar fissure structures are found. This type of mechanical expression is so common that it can be compared with the rock joint on the earth (MA and DEN, 1965). What should be stressed is the importance of the widely generated shear fissures. With the experiment on the fracture of a rock, one can reason that this type of fissure is always formed under the condition of stable pressure or the confining pressure and it is neither the result of impact force nor the explosion caused by heat, and it is the same condition as the regional structural force in the earth which produces the shear joint. This widely generated conjugated shear joint, is actually a kind of plastic slip phenomenon. We may think of the network structure observed on the surface of the Mars and other terrestrial planets. Both of them might have resulted from regional structural force. According to the opinion of MIYASHIRO (1966) about the behavior of minerals under directive pressure, the central pressure of the meteorite parent body would not be greater than 20 kb. He also believed that the radius of the parent body would not be over 1000 km. If the parent body of the Jilin meteorite shower were smaller in size, or much smaller, it would have enough regional structure force so as to produce the widely generated shear fissure. More work has to be done to prove it. If the above-mentioned point can be confirmed, it will be a good clue to establish a historical relation between single meteorite and its parent body and it would be helpful to the understanding of the mechanical condition of a small celestial body in the asteroid zone.

References

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